What is claimed is:

1   1.   A method of predicting failure in a process having associated metrics and a plurality

2   of operational variables, the method comprising the steps of:

3   using non-linear regression to predict values for a first set of operational variables

4   based on two or more prior values thereof;

5   using non-linear regression to predict a plurality of process metric values based on

6   the first set of predicted values and prior values of two or more operational variables; and

7   determining a likelihood of a process failure based on one or more of the

8   predicted process metric values.

1   2.   The method of claim 1, wherein the first set of predicted values is predicted by

2   applying a separate non-linear regression model to each of the process operational variables,

3   wherein each of the separate non-linear regression models has been trained in the relationship

4   between a single process operational variable and prior values of two or more process

5   operational variables.

1   3.   The method of claim 2, further comprising repeating the steps of the method for at

2   least one sub-process of the process.

1   4.   The method of claim 2, further comprising repeating the steps of the method for a

2   higher-level process comprising the process.

1   5.   A method of predicting failure in a process having a plurality of operational variables

2   associated therewith, the method comprising the steps of:

3   using non-linear regression to predict values at a first time for a first set of

4   operational variables based on two or more prior values thereof;

5   using non-linear regression to predict values at a second time for a second set of

6   operational variables based on two or more prior values thereof; and

7   determining a likelihood of a process failure based on one or more of the

8   predicted values for the process operational variables at the first time and the second

9   time.

1   6.   The method of claim 5, wherein the second set of process operational variables are at

2   least a subset of the first set of process operational variables.

1   7.   The method of claim 5 further comprising using non-linear regression to predict

2   values at a third time for a third set of operational variables based on two or more prior

3   values thereof.

1   8.   The method of claim 7 further comprising using non-linear regression to predict

2   values at a fourth time for a fourth set of operational variables based on two or more prior

3   values thereof.

1   9.   A method of predicting the need for maintenance activities for a process having a

2   plurality of operational variables associated therewith, the method comprising the steps of:

3   using non-linear regression to predict values at a first time for a first set of

4   operational variables based on two or more prior values thereof;

5   using non-linear regression to predict values at a second time for a second set of

6   operational variables based on two or more prior values thereof; and

7   determining the need for a maintenance action based at least in part on a

8   comparison of the first set of predicted values with the second set of predicted values.

1   10.   The method of claim 9 wherein the determining step is also based on process yield

2   metrics.

1   11.   The method of claim 9 wherein the step of predicting the second set of values at the

2   second time is also based on process yield metrics.

1   12.   The method of claim 9 wherein the first set of predicted values at the first time is

2   constrained by cost data.

1   13.   The method of claim 9 wherein the second set of predicted values at the second time

2   is constrained by cost data.

1   14.   A system for predicting events of a process having associated operational variables,

2   the system comprising:

3   (a) a process monitor for monitoring operational variables; and

4   (b) a data processing device for receiving, from the process monitor, data indicative

5   of values of the operational variables, and predicting events based on (i) a relationship

6   between a first set of predicted values for a first set of process operational variables and two

7   or more prior process operational variable values thereof, (ii) a relationship between a second

8   set of predicted values for a second set of process operational variables and two or more prior

9   process operational variable values thereof, and (iii) a relationship between a predicted

10   process event, the first set of predicted values, and the second set of predicted values.

1   15.   The system of claim 14 wherein the process event is a process failure.

1   16.   The system of claim 14 wherein the process event is a maintenance activity.

1 17. A system for predicting failure in a process having associated operational variables,

2 the system comprising:

3 (a) a process monitor for monitoring operational variables; and

4 (b) a data processing device for receiving, from the process monitor, data indicative

5 of values of the operational variables, and predicting process failure based on (i) a

6 relationship between a first set of predicted values at a first time for a first set of process

7 operational variables and two or more prior process operational variable values thereof, (ii) a

8 relationship between a second set of predicted values at a second time for a second set of

9 process operational variables and two or more prior process operational variable values

10 thereof, and (iii) a relationship between a process failure, the first set of predicted values at a

11 first time, and the second set of predicted values at a second time.

1 18. A system for predicting the need for maintenance activities in a process having

2 associated operational variables and process metrics, the system comprising:

3 (a) a process monitor for monitoring operational variables; and

4 (b) a data processing device for receiving, from the process monitor, data indicative

5 of values of the operational variables, and predicting process failure based on (i) a

6 relationship between a first set of predicted values at a first time for a first set of process

7 operational variables and two or more prior process operational variable values thereof, (ii) a

8 relationship between a second set of predicted values at a second time for a second set of

9 process operational variables and two or more prior process operational variable values

10 thereof, and (iii) a relationship between a need for a maintenance activity, the first set of

11 predicted values at a first time, and the second set of predicted values at a second time.

1 19. The system of claim 18 further comprising a process controller, responsive to the

2 data processing device, for performing maintenance activities based on the predicted process

3 event.

1   20.   The system of claim 18 further comprising a data storage device for storing one or

2   more of maintenance activity records and maintenance activity costs.